

electronics, for example. Electrical and electronics engineers design new products, write performance requirements, and develop maintenance schedules. They also test equipment, solve operating problems, and estimate the time and cost of engineering projects.

### Employment

Electrical and electronics engineers held about 288,000 jobs in 2000, making their occupation the largest branch of engineering. Most jobs were in engineering and business consulting firms, government agencies, and manufacturers of electrical and electronic and computer and office equipment, industrial machinery, and professional and scientific instruments. Transportation, communications, and utilities firms as well as personnel supply services and computer and data processing services firms accounted for most of the remaining jobs.

California, Texas, New York, and New Jersey—States with many large electronics firms—employ nearly one-third of all electrical and electronics engineers.

### Job Outlook

Electrical and electronics engineering graduates should have favorable job opportunities. The number of job openings resulting from employment growth and the need to replace electrical engineers who transfer to other occupations or leave the labor force is expected to be in rough balance with the supply of graduates. Employment of electrical and electronics engineers is expected to grow about as fast as the average for all occupations through 2010.

Projected job growth stems largely from increased demand for electrical and electronic goods, including advanced communications equipment, defense-related electronic equipment, and consumer electronics products. The need for electronics manufacturers to invest heavily in research and development to remain competitive and gain a scientific edge will provide openings for graduates who have learned the latest technologies. Opportunities for electronics engineers in defense-related firms should improve as aircraft and weapons systems are upgraded with improved navigation, control, guidance, and targeting systems. However, job growth is expected to be fastest in services industries—particularly consulting firms that provide electronic engineering expertise.

Continuing education is important for electrical and electronics engineers. Engineers who fail to keep up with the rapid changes in technology risk becoming more susceptible to layoffs or, at a minimum, more likely to be passed over for advancement.

### Earnings

Median annual earnings of electrical engineers were \$64,910 in 2000. The middle 50 percent earned between \$51,700 and \$80,600. The lowest 10 percent earned less than \$41,740, and the highest 10 percent earned more than \$94,490. Median annual earnings in the industries employing the largest numbers of electrical engineers in 2000 were:

|  |          |
|--|----------|
| Computer and office equipment .....          | \$69,700 |
| Measuring and controlling devices .....      | 67,570   |
| Search and navigation equipment .....        | 67,330   |
| Electronic components and accessories .....  | 65,830   |
| Engineering and architectural services ..... | 65,040   |

Median annual earnings of electronics engineers, except computer, were \$64,830 in 2000. The middle 50 percent earned between \$52,430 and \$79,960. The lowest 10 percent earned less than \$43,070, and the highest 10 percent earned more than \$94,330. Median annual earnings in the industries employing the largest numbers of electronics engineers in 2000 were:

|   |          |
|---|----------|
| Federal Government .....                    | \$70,890 |
| Search and navigation equipment .....       | 68,930   |
| Electronic components and accessories ..... | 63,890   |
| Electrical goods .....                      | 62,860   |
| Telephone communication .....               | 57,710   |

According to a 2001 salary survey by the National Association of Colleges and Employers, bachelor's degree candidates in electrical and electronics engineering received starting offers averaging \$51,910 a year; master's degree candidates averaged \$63,812; and Ph.D. candidates averaged \$79,241.

### Sources of Additional Information

Information on electrical and electronics engineers is available from:

► Institute of Electrical and Electronics Engineers, 445 Hoes Lane, Piscataway, NJ 08855-1331. Internet: <http://www.ieee.org>

(See introduction to the section on engineers for information on working conditions, training requirements, and other sources of additional information.)

## Environmental Engineers

(O\*NET 17-2081.00)

### Nature of the Work

Using the principles of biology and chemistry, environmental engineers develop methods to solve problems related to the environment. They are involved in water and air pollution control, recycling, waste disposal, and public health issues. Environmental engineers conduct hazardous-waste management studies, evaluate the significance of the hazard, offer analysis on treatment and containment, and develop regulations to prevent mishaps. They design municipal sewage and industrial wastewater systems. They analyze scientific data, research controversial projects, and perform quality control checks.

Environmental engineers are concerned with local and worldwide environmental issues. They study and attempt to minimize the effects of acid rain, global warming, automobile emissions, and ozone depletion. They also are involved in the protection of wildlife.

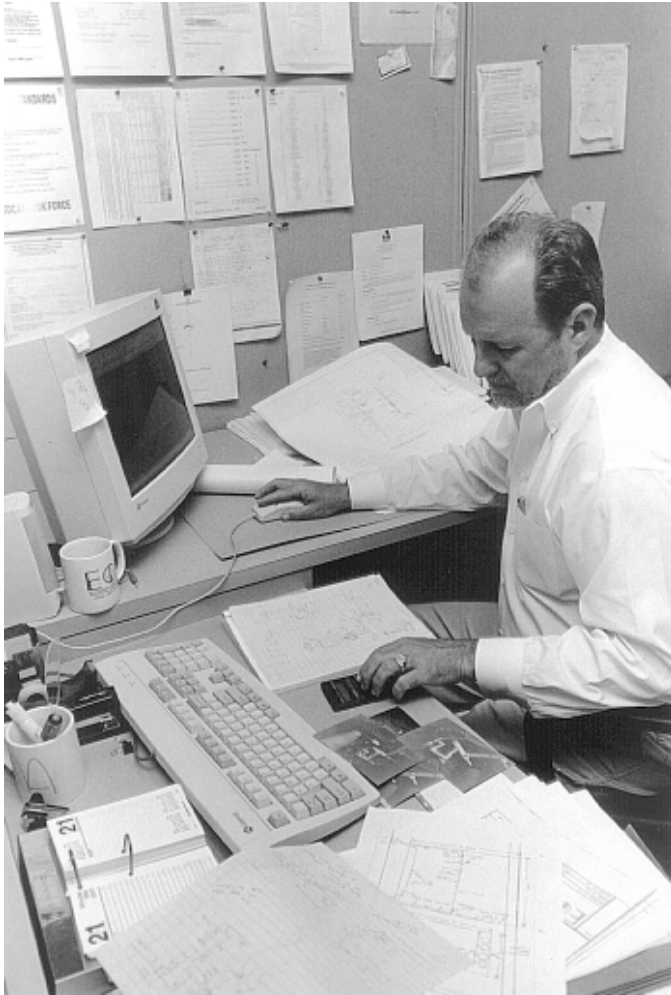
Many environmental engineers work as consultants, helping their clients comply with regulations and clean up hazardous sites, including brownfields, which are abandoned urban or industrial sites that may contain environmental hazards.

### Employment

Environmental engineers held about 52,000 jobs in 2000. More than one-third worked in engineering and management services and about 16,000 were employed in Federal, State, and local government agencies. Most of the rest worked in various manufacturing industries.

### Job Outlook

Employment of environmental engineers is expected to increase faster than the average for all occupations through 2010. More environmental engineers will be needed to meet environmental regulations and to develop methods of cleaning up existing hazards. A shift in emphasis toward preventing problems rather than controlling those that already exist, as well as increasing public health concerns, also will spur demand for environmental engineers. However, political factors determine the job outlook for environmental engineers more than that for other engineers. Looser environmental regulations would reduce job opportunities; stricter regulations would enhance opportunities.



*Although the type of job that environmental engineers have often determines whether they work outdoors, most work in offices the majority of the time.*

Even though employment of environmental engineers should be less affected by economic conditions than that of most other types of engineers, a significant economic downturn could reduce the emphasis on environmental protection, reducing employment opportunities. Environmental engineers need to keep abreast of a range of environmental issues to ensure steady employment because their area of focus may change frequently—for example, from hazardous wastesite cleanup to the prevention of water pollution.

### Earnings

Median annual earnings of environmental engineers were \$57,780 in 2000. The middle 50 percent earned between \$45,740 and \$71,280. The lowest 10 percent earned less than \$37,210, and the highest 10 percent earned more than \$87,290. Median annual earnings in the industries employing the largest numbers of environmental engineers in 2000 were:

|  |          |
|--|----------|
| Engineering and architectural services ..... | \$53,580 |
| State government .....                       | 53,210   |
| Management and public relations .....        | 52,110   |

According to a 2001 salary survey by the National Association of Colleges and Employers, bachelor's degree candidates in environmental engineering received starting offers averaging \$51,167 a year.

### Sources of Additional Information

Further information about environmental engineers can be obtained from:

- American Academy of Environmental Engineers, 130 Holiday Court, Suite 100, Annapolis, MD 21401. Internet: <http://www.enviro-engrs.org>

(See the introduction to the section on engineers for information on working conditions, training requirements, and other sources of additional information.)

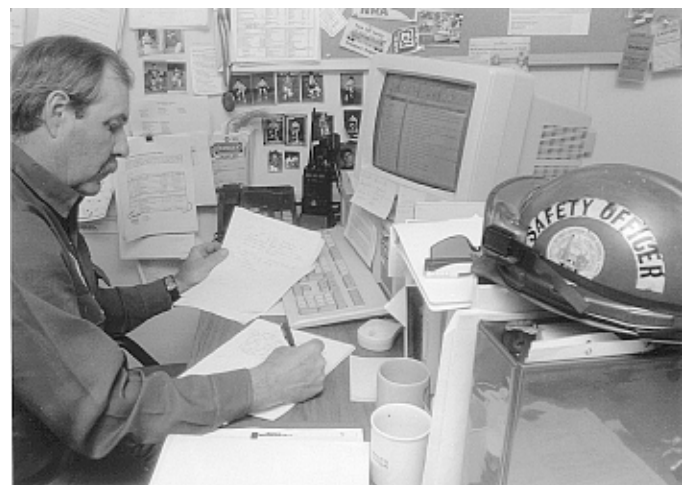
## Industrial Engineers, Including Health and Safety

(O\*NET 17-2111.01, 17-2111.02, 17-2111.03, 17-2112.00)

### Nature of the Work

Industrial engineers determine the most effective ways for an organization to use the basic factors of production—people, machines, materials, information, and energy—to make a product or to provide a service. They are the bridge between management goals and operational performance. They are more concerned with increasing productivity through the management of people, methods of business organization, and technology than are engineers in other specialties, who generally work more with products or processes. Although most industrial engineers work in manufacturing industries, they also work in consulting services, healthcare, and communications.

To solve organizational, production, and related problems most efficiently, industrial engineers carefully study the product and its requirements, use mathematical methods such as operations research to meet those requirements, and design manufacturing and information systems. They develop management control systems to aid in financial planning and cost analysis, design production planning and control systems to coordinate activities and ensure product quality, and design or improve systems for the physical distribution of goods and services. Industrial engineers determine which plant location has the best combination of raw materials availability, transportation facilities, and costs. Industrial engineers use computers for simulations and to control various activities and devices, such as assembly lines and robots. They also develop wage and salary administration systems and job evaluation programs. Many industrial engineers move into management positions because the work is closely related.



*Health and safety engineers anticipate and evaluate hazardous conditions and develop hazard control methods.*